PREPARATION NOTICE

FOR THE

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

TO THE ENVIRONMENTAL IMPACT STATEMENT

FOR THE

KAHAUALE'A GEOTHERMAL PROJECT

APPLICANT:

THE ESTATE OF JAMES CAMPBELL
IN COORDINATION WITH
THE TRUE/MID-PACIFIC GEOTHERMAL VENTURE

JULY 1985

PREPARED BY:

TRUE/MID-PACIFIC GEOTHERMAL, INC.
HONOLULU, HAWAI'I

PREPARATION NOTICE

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TO THE ENVIRONMENTAL IMPACT STATEMENT FOR THE
KAHAUALE'A GEOTHERMAL PROJECT
PUNA DISTRICT, ISLAND OF HAWAII
HAWAII

TAX MAP KEYS: No. 1-2-10, Parcel 3
No. 1-2-10, Parcel 2 and
No. 1-2-10, Parcel 1

APPLICANT:

THE ESTATE OF JAMES CAMPBELL
828 Fort St. Mall, Suite 500
Honolulu, Hawaii 96813

In Coordination with
THE TRUE/MID-PACIFIC GEOTHERMAL VENTURE

This Environmental Document is Submitted
Pursuant to Chapter 343, HRS

ACCEPTING AUTHORITY:

CHAIRMAN, BOARD OF LAND AND NATURAL RESOURCES
State of Hawaii

PREPARED BY:
TRUE/MID-PACIFIC GEOTHERMAL VENTURE
Honolulu, Hawaii

JULY 1985

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INTRODUCTION

The Environmental Impact Statement (EIS) for the Kahauale'a Geothermal Project, Puna District, Island of Hawaii, was approved by the Board of Land and Natural Resources on July 30th, 1982. The EIS for Kahauale'a was submitted in support of a Conservation District Application (CDUA) for a permit to conduct geothermal exploration and development activities within the boundary of Kahauale'a.

Subsequent to approval of the Environmental Impact Statement for the Kahauale'a Geothermal project, the State legislature enacted two laws dealing with geothermal development; (Act 296, Session Laws of Hawaii, 1983 and Act 151, Session Laws of Hawaii, 1984). These acts provided that "geothermal development activities" could occur in any of the land use districts in the State within specified boundaries established by the Board of Land and Natural Resources (BLNR) as a Geothermal Resource Sub-zone (GRS) in accordance with criteria established in the Acts, but subject to application for and issuance of all required permits on a project-by-project basis. Act 296 defined Geothermal development activities as those activities associated with the exploration and development of geothermal resources and the production of those resources to generate electrical energy. A portion of Kahauale'a was designated by BLNR as a geothermal resource sub-zone by BLNR Decision and Order of 28 December 1984.

In the foregoing Decision and Order, BLNR also proposed that the landowner of Kahauale'a (the Estate of James Campbell) consider a land exchange of Kahauale'a for adjoining State-owned land in the middle east rift zone

of Kilauea (the Puna Forest Reserve, the Wao Kele O Puna Natural Area Reserve, and such other adjacent State land as would be appropriate). If such exchange is determined to be feasible and is consummated in conjunction with the designation of a suitable GRS within the exchanged State lands, geothermal development activities in this area of the Kilauea east rift zone would occur in the exchanged lands rather than Kahauale'a.

Upon the designation of a GRS within the lands to be exchanged and upon issuance of the proper permits for geothermal development in the State lands to be exchanged, the land exchange would be considered completed and the presently designated GRS for Kahauale'a and the Wao Kele O Puna Natural Area Reserve would be terminated. A Natural Area Reserve would then be designated in Kahauale'a.

The landowners (Campbell Estate and the State) have agreed in principal to the proposed land exchange consisting of 20,000 to 25,000 acres from each land area, as shown in Figure 2, subject to appraisal. The Legislature, during the 1985 session, passed unanimously a joint resolution which indicated the Legislature was favorably disposed to the State's proposed land exchange. Steps have been initiated between the parties to undertake the actions required to appraise the separate values of the affected lands and consummate the land exchange. In addition, action has been initiated by the State to designate additional portions of the Kilauea east rift zone as a geothermal resources sub-zone, which will include a portion of the lands to be exchanged.

The "accepting authority" for the EIS, (The Board of Land and Natural Resources) has determined that as a result of relocating proposed geother-

mal development activities to the adjoining State lands, a Supplemental Environmental Impact Statement (SUP EIS) is required to describe and document the changes in the environmental setting of the proposed action and to determine whether there would be any changes in the environmental impacts predicted in the EIS for the proposed geothermal development activities, or in the mitigation measures described therein the EIS to reduce or prevent those impacts.

This Supplemental Environmental Impact Statement Preparation Notice and the SUP EIS, are being prepared on the assumption that the State's proposed land exchange will occur. All information in the EIS that is not directly affected by this planned relocation of the project site to adjoining State land remains valid, is applicable to the SUP EIS, and is incorporated in the SUP EIS by reference by authority of the Board of Land and Natural Resources.

SECTION I

APPLICANT

The Estate of James Campbell in coordination with the True/Mid-Pacific Geothermal Venture.

SECTION II

ACCEPTING AUTHORITY

Chairman, Board of Land and Natural Resources, State of Hawaii.

SECTION III

AGENCIES CONSULTED IN MAKING ASSESSMENT:

(The requirement for an EIS for geothermal development activities on conservation lands (Kahauale'a) has been previously determined. The EIS has been approved. In conjunction with the decisions related to the proposed land exchange of Kahauale'a for adjoining state lands, the BLNR has determined that a supplemental environmental impact statement would be required. Its purpose is to identify any changes in the environmental setting of the adjoining parcel and whether any such changes would result in (1) different environmental impacts (from geothermal development activities) than those described in the EIS, or (2) in different measures or procedures than those described in the EIS to reduce or avoid those impacts. Therefore, an environmental assessment on which to determine the need for a supplemental environmental impact statement for the proposed action is not required.)

SECTION IV

GENERAL DESCRIPTION OF THE ACTION'S TECHNICAL, ECONOMIC, SOCIAL AND ENVIRONMENTAL CHARACTERISTICS

A. TECHNICAL CHARACTERISTICS

1. Objectives

The State of Hawaii is almost totally dependent on imports of crude oil and petroleum products and is vulnerable to supply disruptions and price fluctuations in the global energy market. As a consequence of the high cost of imported fuel, electricity rates in Hawaii are among the highest in the nation.

Because of Hawaii's recent volcanic origin and geography, the State has no indigenous fossil fuel reserves and is isolated from systems such as coal and natural gas. Fortunately, Hawaii is rich in renewable energy resources which is becoming available under new and improved technologies. Those resources include geothermal, solar, wind, biomas, hydropower, and ocean thermal gradients.

Because of the abundance of renewable natural resources in Hawaii, the State's efforts are now directed toward decreasing the dependence upon imported fuel and focusing on the development of indigenous energy sources such as geothermal energy.

In 1978, the State Legislature eneacted the Hawaii State Plan, Chapter 226 of the Hawaii Revised Statutes. The purpose of the plan is to improve the State-wide planning process, which is to

articulate goals, objectives, and policies intended to guide future development in Hawaii. The State Plan defines two energy objectives. The first is to provide a dependable, efficient, and economical State-wide energy system capable of supporting the current and future needs of the people of Hawaii. The second is to provide increased energy self-sufficiency by decreasing Hawaii's dependence on imported fuel.

The amended General Plan of the County of Hawaii places emphasis upon energy self-sufficiency because of the excessive dependence on imported oil and the escalating cost of electricity. The County's objectives include energy self-sufficiency and the establishment of the Big Island as a demonstration community for the development and use of natural energy resources.

The objective of the proposed project is to explore for and develop the geothermal resources within the State lands to be exchanged, Puna District, Island of Hawaii, to produce electricity as a major contribution toward achieving the above energy objectives of the State and County Plans.

2. Description of Proposed Action

a. Administration

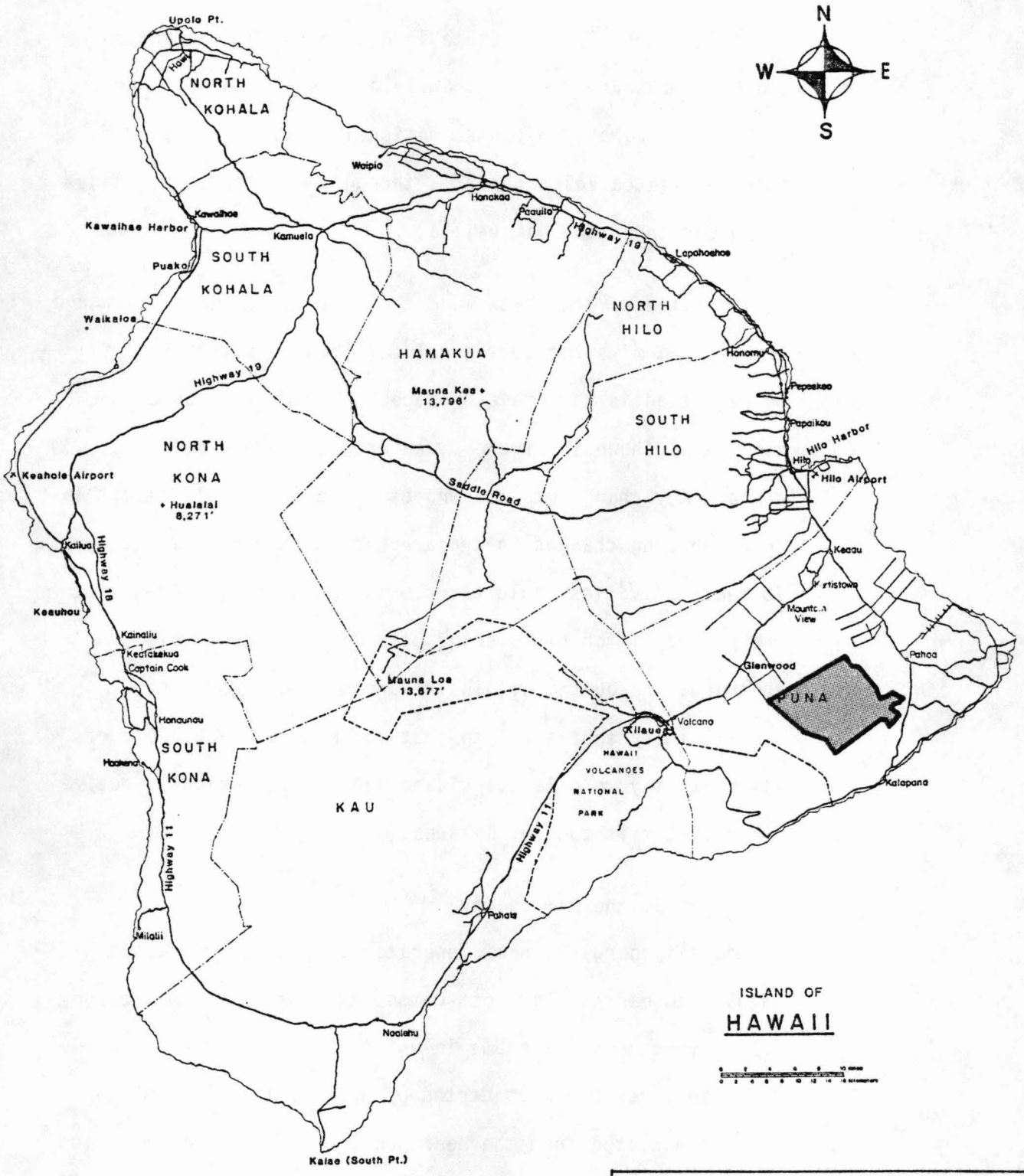
A Supplemental Environmental Impact Statement (EIS) is required in support of a revised Conservation District Use

Application (CDUA) and a Geothermal Mining Lease Application by Campbell Estate, prospective fee owner and geothermal mining lessee of the State land to be exchanged. This Supplemental EIS Preparation Notice serves the following purposes: (1) Provides regulatory agencies and the public preliminary information on the Board's determination of the requirement of the applicant to prepare a Supplemental EIS due to relocating of proposed geothermal development activities to land adjoining the original site for development as described in the EIS and (2) allows appropriate agencies and interested individuals and citizens groups to request to be consulted parties in the assessment process prior to filing the Supplemental EIS with the Environmental Quality Commission for distribution.

The proposed geothermal project is a joint enterprise of The Estate of James Campbell and the True/Mid-Pacific Geothermal Venture, an experienced energy exploration and development group from Casper, Wyoming.

b. Location

The project location within the Puna District of the Big Island is indicated in Figure 1. The State lands being appraised for exchange with Campbell Estate lands include Conservation District lands, (the Puna Forest Reserve and the Wao Kele O Puna Natural Area Reserve) and agricultural land as



Location of Project Area

Project Location
Puna District
Island of Hawaii

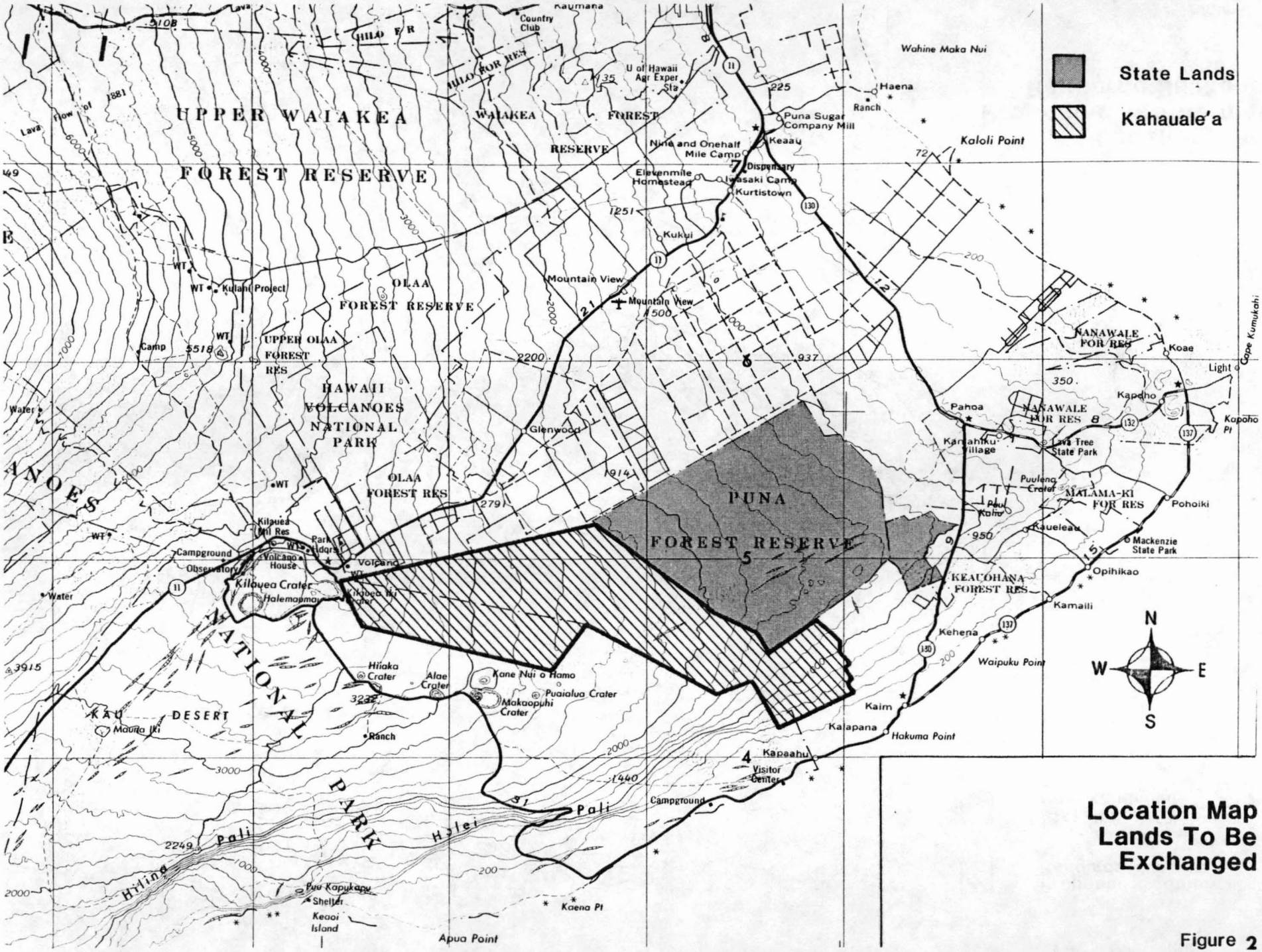
Figure 1

shown in Figure 2. The State land adjoins the eastern and southern boundary of the Kahauale'a ahupua'a which is adjacent to the Hawaii Volcanoes National Park. The east rift zone of Kilauea Volcano passes through both the State lands to be exchanged and Kahauale'a.

That portion of the State lands being considered for exchange in which permits for geothermal development activities will be requested is the State proposed geothermal resource sub-zone (GRS) shown in Figure 3, an area of approximately 11,000 acres. Any changes to the proposed sub-zone would result in corresponding changes in the area in which geothermal development activities would occur. It has been estimated that the potential for discovering economically producible geothermal resources within the proposed GRS would be approximately equivalent to that for Kahauale'a because of its proximity to Kilauea Volcano and the volcanically active upper east rift zone of Kilauea.

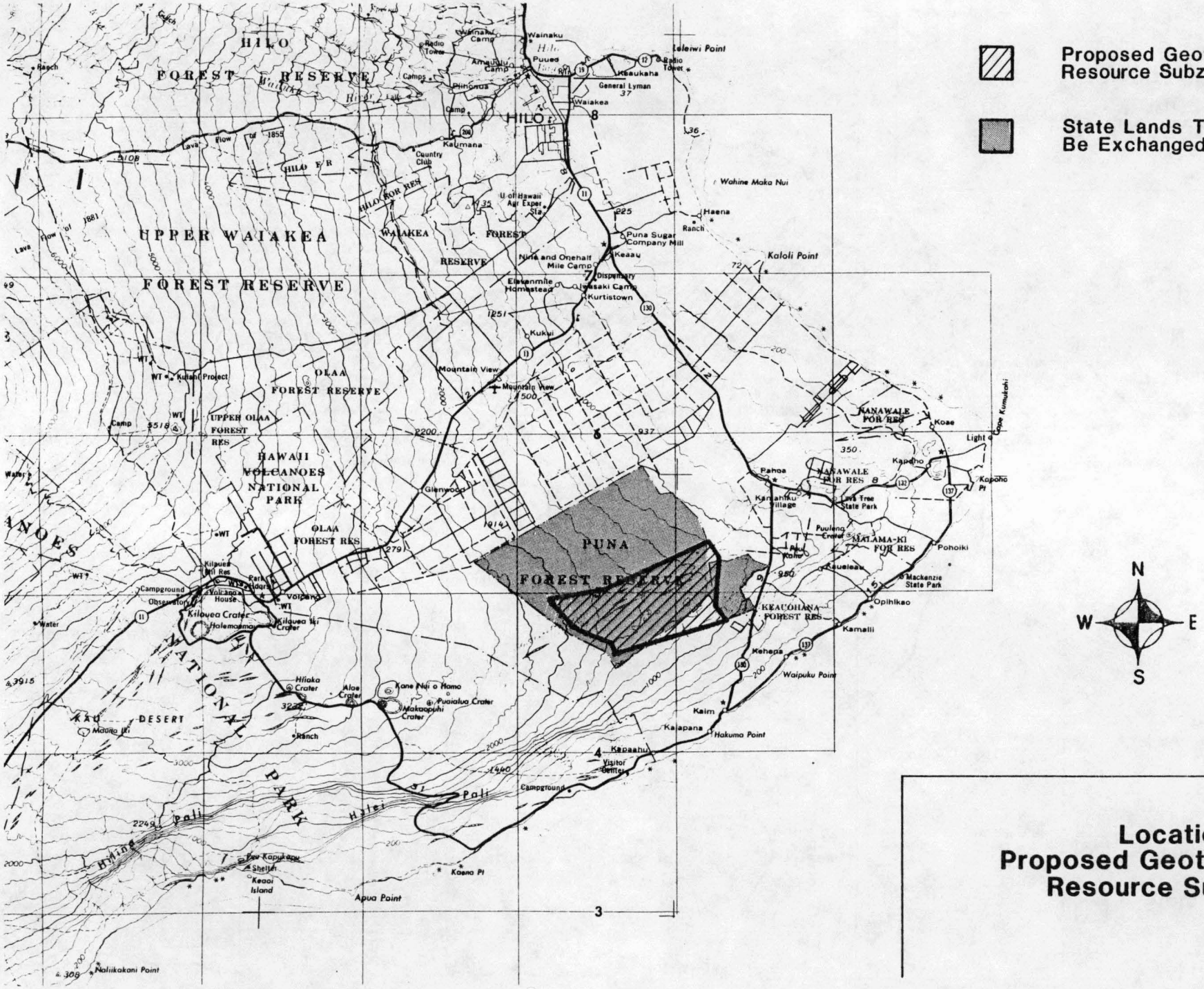
c. Nature of Geothermal Energy

Geothermal energy is heat generated by natural processes within the earth. The most common type of geothermal energy is in hydrothermal systems in which ground water has accumulated in a reservoir at depths of up to 2 miles below sea level and heated from the near presence of a magma intrusion from greater depths. These systems may be liquid (common) or



Location Map
Lands To Be Exchanged

Figure 2


Proposed Geothermal Resource Subzone
State Lands To Be Exchanged
PUNA FOREST RESERVE
HILO FOREST RESERVE
UPPER WAIAKEA FOREST RESERVE
WAIAKEA FOREST RESERVE
OLAA FOREST RESERVE
UPPER OLAA FOREST RES
HAWAII VOLCANOES NATIONAL PARK
KAU DESERT
KEAUOHANA FOREST RES
MALAMA-KI FOR RES
KANAWALE FOR RES
HILO
Kaumana
Puna Sugar Company Mill
Kurtistown
Mountain View
Glenwood
Volcano House
Kilauea Crater
Halemaumau
Kilauea Iki Crater
Hilina Pali
Pali
Apua Point
Kaena Pt
Kaalaiki Point
Kaloli Point
Leleiwi Point
Waipuku Point
Hakuma Point
Kapaahu
Visitor Center
Campground
Pahoa
Kapoho
Kapoho Pt
Lava Tree State Park
Pohoiki
Opihikao
Kamaili
Kehena
Kaimu
Kalapana
Keaau
Haena
Wahine Maka Nui
Koae
Light
Cape Kumukahi
N
W
E
S
Location Map
Proposed Geothermal
Resource Subzone
Figure 3

vapor (rare) dominated and temperatures of the water or steam may vary from 90° C to over 300° C. The hot water and/or steam can be recovered from these resources by drilling into the reservoir through sealed and cemented steel pipes. In liquid dominated systems of sufficiently high temperatures, hot water is converted or flashed to steam as it flows up the well bore or as it reaches a separator under reduced pressure from which it is directed into a turbine-generator to generate electricity.

d. Geothermal Development Activities

Fundamentally, development of geothermal resources to provide electricity involves drilling of wells, testing and analysis of discovered resources, construction of power plants and transmission lines, production of wells, and operation and maintenance of facilities.

The initial, or exploration phase involves:

(1) Exploratory drilling with a rotary rig (approximately 150 ft. in height) to depths of 4,000 feet to 8,000 feet below sea level to intersect a geothermal reservoir of hot water or steam, or a combination of water and steam. Drilling of a well is normally continuous until the targeted depth is reached. The well bore is cased with steel pipe and cemented from surface to the desired

depths. Several exploratin wells may be required to discover a reservoir and to determine its direction and some indications of its dimensions.

(2) Flow testing of the wells that intersect a reservoir is required to analyze the quality and characteristics of the resource and reservoir (temperature, pressure, flow rate, chemical analysis, ratio of steam to water, etc.). This information provides the basis for a decision on whether the resource at that particular site can be economically produced to generate electricity. Flow testing of exploratory wells, under controlled conditions to abate noise and emissions, normally, will require up to 30 days. During testing, the well flow is allowed to percolate into the ground at the drilling site as is being done at the HGP-A site.

The development phase involves:

(1) Activities leading to the commercial production of the discovered geothermal resources. If a discovered geothermal reservoir is determined to be economically producible for generation of electricity, and there is a market demand for some level of power generation, additional (development) wells will be drilled to combine with one or more successful exploration wells to produce

that amount of power. Additional exploration wells may have to be drilled to "prove" the existence of other reservoirs within the GRS during the development phase.

(2) Concurrently, a power plant and related facilities are designed to generate the required amount of power and to control emissions to meet required air quality standards. An application to construct the power plant is submitted to the BLNR and to the Health Department. Supporting information must demonstrate that the emissions abatement and back-up systems will enable compliance with applicable Federal and State regulations on air quality standards under all anticipated meteorological conditions. The power plant is sited at the well head or drilling site or within approximately 2 miles of the wells that will supply the power plant.

In the production phase, wells are opened to flow into a separator where filtered steam is drawn into the turbine generator to produce electricity. Fluid not converted to steam in the separator and the fluid from the condenser (cooled in a cooling tower) are reinjected in a sealed well bore to approved, pre-determined depths.

e. Scope of Proposed Action

The scope of project activity planned within the geothermal

resource sub-zone of the State land to be exchanged is to develop, incrementally, the optimal geothermal energy potential of the prospective sub-zone subject to future power demands or market and the assessment of environmental impacts at each increment of development.

The first development increment for the proposed geothermal project represents the scope of action on which this SUP EIS is based. Project activities that would occur during the first development increment include the following:

- preparing a primary and alternate access road into the GRS of the land to be exchanged.
- preparing separate drilling sites of 2 to 3 acres for each well. (In the development phase, directional drilling from the same site, when feasible, will reduce the number of drilling sites required.)
- constructing internal service roads to connect drilling and power plant sites.
- drilling and testing of up to 35 exploration and/or development wells.
- constructing electrical power plants at the drilling site or within 2 miles of the producible wells as the need for power is created. The first development increment on which this SUP EIS is based would not exceed a production level of 100 MW of electricity;

the capacity of power plants at any one site could vary from 5MW to 55MW and would require a surface area of 5 to 8 acres each. The first power plant is expected to have a capacity of 10-15 MW of power.

- connecting the producing wells to the power plants with steel pipelines, 12" to 20" in diameter.
- drilling up to 8 injection wells as may be required to reinject geothermal fluid after its useable energy is extracted during production operations.
- constructing a power transmission line from power plant to the boundary of the GRS to interconnect with HELCO's transmission lines.

Since the presence of a geothermal resource and the extent of its reservoir can only be determined by deep exploration drilling, and since geothermal power plants must be located generally within 2 miles of its producing geothermal wells, it is not possible to prelocate these sites. The ultimate location and size of each power plant, as governed by the location and quality of the resource, must be approved on a site specific basis by DLNR or the County Planning Department as appropriate.

Similarly, because of the uncertainty of the quality of the resource and the production capability of each well, the approximate lowest individual well production level

considered economically producible is used to estimate the maximum number of wells needed to generate the proposed production level for each development increment.

The SUP EIS will include a development concept for the first increment of development within the designated GRS which will allow evaluation of the types and tentative locations of facilities, access roads and tentative service roads, and the approximate surface area required for the level of development activities proposed. The development concept will provide a basis for calculating the potential impacts of the activities proposed and the measures necessary to reduce, avoid, monitor and control those imapcts. On approval, the development concept will serve as a control document for the level of development activities approved in this increment.

Prior to any development activity being initiated within the GRS of the State lands to be exchanged, a "Plan of Operations" is required to be submitted for approval to the Chairman of the Board of Land and Natural Resources in accordance with Chapter 183, (Rules on Leasing and Drilling of Geothermal Resources), Administrative Regulations, DLNR. Any changes to the Plan of Operations require approval of the Chairman, BLNR. In addition, each well to be drilled requires a separate permit from the Chairman, BLNR, and the County if drilling is on agricultural land.

The precise (surveyed) location of the initial drilling site as well as all subsequent drilling sites in this development increment, the exact location, capacity and design of electrical generating plants and the alignment of service or connecting roads between power plants and drilling sites will be included in individual permit applications to the Department of Land and Natural Resources, the Department of Health, EPA, and the County Planning Department as appropriate under existing law and regulations.

The combined effect of these individual permit applications (to be submitted as required during the period of development in the first development increment) will be consistent with the scope of development activities proposed and approved for this increment including the estimates of dimensions of all facilities, surface requirements, and impacts. All activities for which individual permits are required and the information or procedures in support of those applications will be in compliance with the Federal, State and County laws and regulations which govern activities associated with geothermal development.

B. ECONOMIC CHARACTERISTICS

It is estimated that each well with a depth of 8,000 feet will cost $1.7 to $2.5 million dollars which includes labor costs, site prepara-

tion, drilling pipe, cement, casing, drilling supplies and equipment operating costs. It is estimated that 8 wells will be required to supply a 25 MWe power plant at a cost of $13.6 to $20.0 million. A power plant using current design practices is expected to cost $1,200 to $1,600 per KW (1984 dollars) of generating capacity (e.g., a 25 MWe power plant could cost between $30.0 and $40.0 million). The gathering system (well head equipment, pipelines, separators) will cost approximately 20 percent of the cost of the consumer facility (power plant), or $6.0 to $8.0 million for a 25 MWe power plant. Field maintenance operations, including reworking of wells and drilling replacement wells, are expected to cost $2.7 million per year for a production system capable of supplying a 25 MWe power plant.

A royalty of 10% of gross sales of geothermal resources would be paid to the State except under circumstances where the Board of Land and Natural Resources determines that a reduction or waiver of the royalty for a limited period of time, not to exceed eight years, would be essential for development to be initiated or continued at a particular site.

C. SOCIAL CHARACTERISTICS

The primary objective of the proposed action is to discover geothermal resources and to convert those resources into electricity to replace imported oil. The utility companies are almost totally dependent on

imported oil for the generation of electricity. The State is therefore continually vulnerable to a disruption in supply of those resources or to sudden and dramatic price escalations due to policy decisions by oil producing countries or increasing world demand for a depletable resource.

Geothermal development involves well established technical and construction activities such as drilling and testing of wells, preparing sites, and constructing roads, power plants, pipe lines, and transmission lines, and the continuing operation and maintenance of those activities. Except for the initial drilling crew and some initial supplies, most of the labor and materials and service support can be satisfied locally.

Inasmuch as the primary objective of the development activity is to discover a local, natural energy resource to replace an existing generating system that uses imported oil, the social aspects of the proposed action from the community standpoint would not be the same as an action that introduced into the community a major new industry or process. Geothermal development is capitol intensive rather than labor intensive. Since a major portion of the labor and follow-on supplies for construction and continuing operations and maintenance related to geothermal development can be provided locally, there would be no need for an in-migration of people for geothermal development and operations activities.

It is believed that the nature of the proposed action that would occur in the geothermal resource sub-zone of the State lands to be exchanged, will not adversely affect life styles, goals or standards in the surrounding communities. Nevertheless, meetings will be held with individuals and associations in these communities to discuss details of the proposed development activities and to obtain community views on this project.

The assured availability of locally produced energy and the increased economic activity in the County as well as the State which would result if geothermal development is successful would be expected to have generally positive long term social implications for the entire community.

D. ENVIRONMENTAL CHARACTERISTICS

The proposed action requires: access roads into the project site; drilling sites of 2-3 acres each; a rotary drilling rig (145 - 155 ft. in height); production and injection wells; power plant sites of 5 - 8 acres each; electrical generating power plants with capacities from 5MW (megawatts - 1MW = 1,000 Kilowatts) to 55MW with structure heights up to 65 ft.; geothermal fluid transmission pipelines, 14" to 20" in diameter to transmit geothermal fluid from the wells to the power plants; electricical transmission lines; and service/maintenance roads within the project site between wells and power plants.

The surface area required to develop underlying geothermal resources is estimated to be approximately 3 - 5% of the total acreage in the proposed geothermal resource sub-zone. In Hawaii, geothermal development will occur predominantly in the rift zones of active and dormant volcanoes and therefore be subject to the hazards of volcanic activity such as lava flows, faulting and ground cracking and earthquakes.

As to operations, deep wells are drilled on a continuous basis, wells are vented (if required) and tested after completion, construction activity is ongoing, geothermal fluid is produced continually, and power plants are in continuous operation except when down for maintenance.

The principal aspects of the proposed action that have an effect on the environment are: clearing of sites for wells and facilities and for roads; noise from drilling, well-venting, construction activities, and operations; emissions from some of the chemical elements in the geothermal fluid during drilling, testing and normal operations. These aspects and others are discussed in Section VII, "Identification and Summary of Major Impacts and Alternatives."

SECTION V

SUMMARY DESCRIPTION OF THE AFFECTED ENVIRONMENT

The land area in the project area is gradually sloping with elevations

ranging from 2,200 feet down to 1,300 feet. The area within and surrounding the proposed geothermal resource sub-zone is rural, mostly forested with vegetation ranging from high quality native vegetation, with wet ohia forest with dense, 80% canopy to low quality vegetation and open areas devestated by lava flows in and below the rift zone. Exotic plant species are found generally in all areas except the highest quality, closed canopy native ohia forest. There is evidence that portions of the ohia forest in the northeast sector of the State lands have been disturbed by human activity. The Adenophorus Periens, a rare fern, is known to exist in the northwest portion of the area. A portion of the Hawaii Volcanoes National Park southeastern boundary is approximately 2 miles from the western boundary of the State lands to be exchanged.

The Hawaiian Hawk ('Io) and Honeycreeper ('o'u) have been sighted in the area of the Kilauea middle east rift zone.

There are no roads into the proposed geothermal resource sub-zone, and there are no known springs or wells in this area. Rainfall averages 120" per year.

A literature search for evidence of any significant archaeological sites within the State lands to be exchanged will be conducted. An archaeological survey will be made before clearing any site to be used in project operations.

SECTION VI

DISCUSSION OF THE ASSESSMENT PROCESS

The first step is the development of the SUP EIS Preparation Notice which is submitted to the State Board of Land and Natural Resources (the approving agency) for filing with the Environmental Quality Commission (EQC). The EQC will then publish, in the EQC Bulletin, the fact that the applicant intends to prepare a SUP EIS for the proposed action. There is then a 30-day period during which any concerned individual or citizen group may request to be consulted on the proposed action. Written comments will be accepted from all agencies, groups and individuals so that an understanding of the various concerns can be obtained. All comments will be responded to in writing and incorporated in the production of the SUP EIS. The approving agency may extend the waiting period an additional thirty (30) days.

The next step is the development of the SUP EIS which will also be submittted to the State Board of Land and Natural Resources for filing with the EQC. The EQC will then publish in the EQC Bulletin the fact that the applicant has filed a SUP EIS for the proposed project. There is then a second 30-day comment period. Copies of the EIS will be sent to all agencies, citizen groups and concerned individuals that commented on the SUP EIS Preparation Notice. The SUP EIS will also be available at libraries in communities near the project area. From the time of publication, the public has thirty (30) days to make written comment on the SUP EIS to the

Governor's Office of Environmental Quality Control (EQC).

The applicant will respond in writing to comment received within fourteen (14) days from the end of the thirty (30) day review period. The applicant will also incorporate the comments into the Revised SUP EIS and append both the comments and responses to the Revised SUP EIS. The Revised SUP EIS will then be submitted to the approving agency, the Board of Land and Natural Resources, for acceptance. Upon acceptance, the Revised SUP EIS will be filed with the OEQC and Notice of Acceptance will be published in the OEQC bulletin.

SECTION VII

IDENTIFICATION AND SUMMARY OF MAJOR IMPACTS AND ALTERNATIVES

A. OVERVIEW

Evidence accumulated thus far on the use of geothermal energy in the U.S. indicates: that its environmental impacts are more benign than fossil fuel, including petroleum and coal, or nuclear power; that actual impacts from geothermal operations have been minor; that mitigation measures taken to reduce the impacts have been effective and that post operations monitoring has contributed importantly to verification and improvement on the effectiveness of various impact mitigation measures being used.

The substitution of geothermal energy to generate electricity for fossil fuels will result in a net gain in air quality due to the type and quantity of emissions from the two energy sources. However, almost any development construction activities can have a number of impacts on both the environment and the community. The objective is to limit and control the impacts so that they can be acceptable from an environmental standpoint and to the community at large.

For geothermal development activities, the potential impacts can vary widely depending on the location, characteristics of the resource, the level of development, and the measures taken to limit and control the impacts.

B. MAJOR IMPACTS

The major impacts from geothermal development activities can occur as the result of:

1. Clearing for roads, sites and facilities if those sites are in environmentally sensitive areas where flora and fauna could be adversely impacted.

2. Noise from construction of roads, sites and facilities, continuous drilling operations , well testing (including free venting of wells for brief periods to clear the well bore of debris, when necessary, after drilling is completed), and power plant operations, all of which could disturb nearby residents or adversely

affect wildlife habitats. A greater noise impact could occur beyond the limited period needed to clear a completed well bore due to an accidental well venting such as a "blow-out."

3. Emissions from the geothermal (brine and steam) resource as it is brought to the surface during drilling and testing, and during production operations when the geothermal energy is used to generate electricity. Emissions could also occur undergroud and on the surface due to a rupture (blow-out) in the well or the transmission pipeline. The chemical elements generally present in geothermal fluids about which the most concern has been expressed are primarily Hydrogen Sulfide (H_2S), Mercury (H_g), and Arsenic (AS). Hydrogen Sulfide is of concern primarily because of its nuisance odor ("rotten egg smell") at low concentrations.

C. SOCIO-ECONOMIC IMPACTS

The proposed action, together with actions of other geothermal developers, to produce electricity from geothermal resources in lieu of imported oil could contribute to improving the balance of payments of the State which now is experiencing a cash outflow of approximately $1.0 billion annually for this imported energy resource.

A reliable source of locally developed energy resources at stable prices could help to make goods and services produced in Hawaii more competitive with imports.

Local employment would increase during the construction phases of geothermal development, the preponderance of which would be expected to continue over a period of up to 20 years. In addition, local supply and service support companies would realize a direct economical benefit from not only the construction phases of geothermal development, but in the continuing operation and maintenance of the geothermal field production and power generation systems.

To the extent that geothermal development is used to replace imported oil and that local labor pools can accomplish all required construction activities, there would be little if any effects on housing, schools and other community and governmental services.

There is also a significant potential for direct uses of geothermal fluid which would benefit primarily the local economy on the island with the geothermal resource, but also the State as a whole. Geothermal direct use activities are not allowed in a GRS within a Conservation District. Examples of direct uses include:

Geothermally heated spas which in the tourist industry attracts thousands of tourists in those countries having this natural resource;

The processing and drying of agricultural products;

Aquaculture operations where goethermal fluids could be used to maintain optimal growing temperatures;

Geothermal energy may ultimately be used in the energy intensive process of desalination of water as Hawaii's water supply and demand projections become unfavorable within the next 15 years, and for pumping of water for irrigation, and for replenishing reservoirs.

As to the impacts of geothermal development activities on the cultural aspects of a community, there will be concerns that such activity in a quiet, rural area will degrade aesthetic qualities especially if the activity can be closely observed along sensitive, natural background view corridors and if effective mitigation measures are not taken.

In addition, there may be religious and cultural concerns of some members of the community including especially those native Hawaiians who feel that development of geothermal resources for commercial purposes is in conflict with traditional Hawaiian beliefs regarding the volcano goddess, Pele. Meetings with individuals and community gorups will be essential to discuss these aspects of geothermal development.

D. ALTERNATIVES

(1) The alternative to geothermal development is development of some other form of energy to replace oil. Coal would probably be the principal fuel to replace oil for generating electricity in the near term should there be a disruption in oil supplies or the

price escalates to unacceptable levels. Sugar companies may have to resort to coal fired power generation if bio-mass (bagasse) production declines. Wind, bio-mass and solar systems can contribute to the alternate energy needs of the State, but as to the significant quantity of firm, base-load power needed by the utility companies, geothermal energy has the best potential to meet those needs in this century and several decades into the next century. The technology for production and conversion of geothermal energy into electricity has been developed and demonstrated through years of use.

(2) The alternative to conducting geothermal development operations in the State lands to be exchanged in the event the exchange is not consummated is to conduct such operations in the geothermal resource sub-zone of Kahauale'a.

(3) The alternative procedures and courses of action which can be exercised to reduce and control the above described impacts are discussed below in Section VIII, "Proposed Mitigation Measures."

SECTION VIII

PROPOSED MITIGATION MEASURES

1. Measures to Reduce Impacts of Clearing Operations

   a. Avoid or limit clearing of the most environmentally sensitive

areas within the approved GRS.

b. Conduct site specific botanical surveys of any area to be cleared to assure that current conditions/populations are known to serve as a guide in final site selections.

c. Conduct directional (slant) drillling from all drilling sites where feasible to reduce the amount of clearing for drilling sites and connecting service roads.

d. Revegetate areas within sites initially cleared that are not needed for operations or structures.

e. Monitor sensitive areas that have been cleared to detect and control any invasion of exotic growth in these areas.

2. Measures to Reduce the Impacts of Noise Throughout Initial and Continuing Operations.

a. Install noise attenuators (mufflers, shields, enclosures, etc.) on equipment and machinery to reduce the noise levels of various operations to acceptable levels at appropriate receptors.

b. Conduct free venting to clear a completed well bore only when required due to the presence of excessive debris and for safety purposes and then only during daylight hours between 8:00 a.m. and 6:00 p.m.

c. Assure that noise levels from operations meet the County guidelines for allowable noise levels at residential receptors, day and night.

d. Maintain a 24-hour day phone line to receive calls from any members of the community who may be experiencing noise from project operations in excess of allowable limits.

3. Measures to Reduce Impacts from Particle and Chemical Element Emissions

a. Prevent excessive fugitive dust being created during road construction, during drilling with comrpessed air, and by project vehicles.

b. During drilling operations after intersecting a reservoir, monitor and limit H_2S emissions to assure safety standards for the drilling crew and to prevent a nuisance level of H_2S at any residence near the project.

c. During flow testing of successful wells, abate H_2 emissions to prevent nuisance level concentrations at the nearest residence.

d. During design of power plant abatement systems, demonstrate that during the production/operations phase, H_2S emissions can be limited to a level that will meet EPA or currently proposed State standards.

e. During operations, maintain appropriate monitors at pre-determined sites to assure that H_2S emissions are not causing ambient air standards to be exceeded at these sites.

4. Measures to Reduce Visual Impacts

In siting of facilities, determine the location of sensitive view corridors in relation to distances from possible observation points and

consider feasible actions in designs, materials, colors, facility orientation, landscaping and final siting to reduce visual impacts.

SECTION IX

DETERMINATION

In accordance with Chapter 343, Hawaii Revised Statutes, it has been determined that a Supplemental Environmental Impact Statement is required for the proposed actions in the State lands to be exchanged. (See Introduction)

SECTION X

FINDINGS AND REASONS FOR SUPPORTING DETERMINATION

The proposed project for the Kahauale'a Geothermal Project was found by BLNR to have "significant effect" in the context of Section 1:31 of the EIS Regulations. The determination was based on (1) the potential impacts of the proposed development upon the environment and (2) land use regulations requiring an EIS for proposed commercial actions on conservation lands.

The relocation of the proposed action (geothermal development activities) to adjoining State lands does not alter the basis for the previous findings requiring an EIS. However, a Supplemental EIS is required to describe and

document changes in the environmental setting of the proposed action and to determine whether there would be any changes in the environmental impacts predicted in the EIS for the proposed geothermal development activities, or in the mitigation measures described therein to reduce or prevent those impacts.

APPENDIX A

AGENCIES TO BE CONSULTED DURING THE PREPARATION OF THE SUP EIS

1. FEDERAL

Department of the Interior - National Park Service - Hawaii Volcanoes National Park
Department of the Interior - U. S. Geological Survey - Hawaii Volcano Observatory
Department of the Interior - U. S. Fish and Wildlife Service - Hawaii Volcanoes National Park

2. STATE

Department of Land and Natural Resources
Department of Planning and Economic Development
Department of Health
Environmental Quality Commission
University of Hawaii - Hawaii Natural Energy Institute
University of Hawaii - Hawaii Institute of Geophysics
University of Hawaii - Environmental Center
State Legislators from Big Island
Office of Hawaiian Affairs
State Public Utilities Commission

3. COUNTY

Department of Planning
Department of Public Works
Department of Water Supply
Department of Research and Development
Department of Civil Defense
County Council
Fire Department

4. PRIVATE

Alu Like
Audubon Society
Chamber of Commerce - Big Island
Fern Forest Community Association
Glenwood Community Association
Hawaii Contractor's Association
Hawaiian Electric Light Company
Japanese Chamber of Commerce and Industry

4. PRIVATE (Cont.)

Kalapana Community Association
Leilani Community Association
Mountain View Community Association
Nature Conservancy
Pahoa Community Association
Puna Hui Ohana
Sierra Club
Volcano Community Association